

SECTION 15200

HEATING

PART 1 - GENERAL REQUIREMENTS

1.1References

- A. All sections of Division 1.
- B. Examine all drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section. Work shall be coordinated with other trades prior to installation to prevent interference and relocations.

1.2Scope

- A. Perform all work and provide all material and equipment as shown on the Drawings or as specified under this Section. All work shall be completely coordinated with the work of all trades and shall provide for a complete and fully functional installation in all respects.
- B. Drawings and Specifications shall be taken together; provide as though mentioned in both, work specified and not shown, or work shown and not specified. Although such work is not specifically shown or specified, provide as part of this work, all supplementary or miscellaneous items, appurtenances, devices or materials incidental to or necessary for a sound, secure and complete installation.
- C. The work shall include, but not be limited to, the following:

1.3Related Work In Other Sections

- A. The following work is not included in this Section and shall be performed under other Sections:
 - 1. Excavation and Backfill.
 - 2. Cutting, Patching, Finish Painting.
 - 3. Access Panel Installation.
 - 4. Concrete and Masonry Work.
 - 5. Electrical Power Wiring of Equipment.
 - 6. Finishing and Caulking.

1.4Submittals

- A. After award of contract as soon is reasonably possible, the Contractor shall submit four (4) copies of submittals for equipment and materials listed below. Submittals shall include catalogue cuts and descriptive data showing conformance with this Specification for:

1.5Motors & Starters

- A. Motors for all equipment under this Section shall be designed for quiet operation and shall be guaranteed to run without objectionable noise or vibration. (See Electrical Section for voltage.) All motors shall have overload protection. Loose motors to be energy efficient equal to General Electric Tri-Clad 700, severe duty or Delco E2 motors.
- B. Starters to be supplied by Heating Subcontractor and installed by Electrician if not part of packaged equipment. All starters, whether packaged equipment or not, to be the same manufacturer as provided by the Electrical Subcontractor (and to meet starter section of Electrical Specifications.)
- C. Provide all single phase motors less than 1/2 HP with TT switches, type as required, complete with pilot light. Provide all motors, 1 HP or larger with appropriate starter.
- D. All power wiring to the mechanical equipment and starters and final connections to motor (unless packaged equipment), shall be the Electrical Subcontractors. Control wiring (including conduit, wire boxes, etc.), shall be the responsibility of the Heating Subcontractor.
- E. All motor starters furnished by this Subcontractor shall be either A.C. manual or A.C. magnetic; and have under voltage protection and push-buttons cover mounted in manual type; be size 1 or larger; have built-in start-stop, P.B. station and/or H-O-A selector switches as noted on drawings for magnetic type, have 3 overloads for 3-phase motors; be provided in appropriate NEMA enclosure; have 120 volt control circuit transformers for all magnetic starters; be front operated and have pilot lights in cover.

PART 2 - PRODUCTS

2.1 Piping

- A. Hydronic Piping shall be Type L hard drawn copper tubing, with wrought copper or bronze fittings, and 95-5 or "Silvabrite" solder. Use a minimum 3 elbow swing connection for supply and return risers to heating equipment.
- B. Steam and Condensate Piping:
 - 1. Steam piping shall be Schedule 40 black steel, ASTM A-53 or A-120 screwed joints, and 150 PSI test malleable iron fittings or welded joints with 150 PSI test steel weld flanges, ASTM A-181.
 - 2. Condensate piping shall be Schedule 80 black steel, ASTM A-53 or A-120, screwed joints, and 150 PSI malleable iron fittings or welded joints with 150 PSI test steel weld flanges, ASTM A-181.
- C. Refrigeration Piping:
 - 1. All refrigerant piping shall be Type 'L-ACR' hard drawn seamless copper tubing with wrought copper fittings. All cold piping shall be hung to allow for 3/4" thick covering. All joints (except where required to be flared) shall be made up with brazed (1000°F.) joints.

2. Furnish and install the necessary liquid sight glass indicators, combination filter/drier, liquid solenoid valve and all other required accessories for quiet vibrationless operations for each system.

D. Drain Piping:

1. All drainage piping shall be type-M hard-drawn copper tubing with wrought copper or bronze fittings and 95/5 or "Silvabrite" solder.

E. Gas Piping:

1. All gas piping shall be steel, ASTM A-120, Schedule 40, seamless black steel pipe.
2. Fittings: Shall be malleable-iron, ANSI B16.3, Class 150, standard pattern.

2.2 Valves

- A. All valves shall be manufactured by one manufacturer. Valves 3/4" and smaller shall be rated for a working steam pressure of 150 lbs. Valves 1" and larger shall be rated for a working steam pressure of 125 lbs.
- B. All valves shall be Jenkins Brothers or approved equal, threaded, conforming to the following table.

<u>Valve</u>	<u>Jenkins Bros. Fig.</u>
Gate	370
Globe	106-A
Ball	32-AS
Check	92-A

C. Gas Cocks:

1. 2" and smaller shall be: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.
2. 2-1/2" and larger: MSS SP-78, 175 psi, lubricated plug valve type, semi-steel body, single gland, wrench operated, flanged ends.

2.3 Unions

- A. Unions: ANSI B16.39, Class 150, black malleable iron; female pattern; brass to iron seat; ground joint.
- B. Dielectric Unions: ANSI B16.39, Class 250; malleable iron and cast bronze; with threaded or soldered end connections suitable for pipe to be joined; designed to isolate galvanic and stray current corrosion.

2.4 Ductwork

- A. All sheet metal work shall be erected in a first class and workmanlike manner, in accordance with the latest edition of the sheet metal duct manual published by SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc., unless otherwise specified hereinafter in this Section.
- B. All duct work shall be supported rigidly and be securely braced as specified, by means of angle irons, rods, channel irons, and cross-bracing and adequately attached by approved means to the structure. Hangers shall not be greater than 4'-0" apart. Ducts shall be securely anchored to structure.
- C. All notches for connecting sections of duct, and all grooving seam notches shall not be cut any deeper than necessary to insure tight corners.
- D. All ductwork shall be of the best bloom galvanized steel of gauges specified below and shall be stiffened by the use of galvanized rolled steel or aluminum angles.
- E. All ducts shall be cross-broken. All exposed ducts shall be especially fabricated so as to present a pleasing appearance, with all joints flush.
- F. Ends of duct sections shall be notched and lapped at least one inch and connected with bar slip, S slip or drive caps. Slips shall be made in form of a frame, mitered and riveted at the corners to prevent leakage.
- G. Maximum leakage for all duct systems shall be 5% of design flow.
- H. Duct elbows shall be square or rectangular, with a radius to width ratio of 1.5 unless otherwise specified.

2.5 Diffusers, Grilles, Louvers

- A. Air Outlets
 - 1. Ceiling Diffusers: Square, extruded aluminum frames and multi-core type diffuser to discharge air in 360 degree pattern, with induction vanes; off-white finish. Diffusers shall be Metalaire model 5000-2-S4-IV.
 - 2. Return Air Grille: Square, extruded aluminum frames, perforated aluminum face; off-white finish. Diffusers shall be Metalaire model 7000-R1.
 - 3. Diffusers shall be adjustable pattern, steel construction, with a factory applied white finish, sized as indicated on Drawings. Diffusers shall be installed with a combination louver damper and equalization grid. Square diffuser shall be nominally 24" x 24" suitable for installation on a 2' x 4' lay in suspended ceiling system. Round diffusers shall be suitable for installation on exposed ductwork. Square diffusers shall be Anemostat Model EPLA with LD louver dampers. Round diffusers shall be Anemostat Model C-2 with LD louver dampers, or approved equal.

4. Grilles - provide exhaust and return air grilles sized as indicated in Drawings. Grilles shall be constructed of aluminum with grid openings of 1/2" x 1/2", and 90% free areas, grilles shall have a factory applied white finish. Dampers for balancing shall be provided either with the grilles or in the ductwork. Grilles shall be Anemostat Model GC5, or approved equal.
- B. Louvers - provide louvers as indicated in drawings. Louvers for outside air intake and exhaust shall be constructed of 16 gauge steel with all joints welded, provide weep holes for drainage. Louvers shall have fixed blades set at 45° and shall be suitable for installation in the building construction. Louvers shall have a 1/2" mesh screen. Louvers shall have a 120 volt motor operated damper.
- C. Exhaust Grilles shall be rollformed, aluminum frame and fixed 45° angled aluminum blades. Color shall be off-white. Grilles shall be Metalaire model RH, 10" x 8".

2.6 Exhaust Fans

- A. Duct mounted exhaust fan shall be of the centrifugal, direct drive type. The fan housing shall be constructed of heavy gauge galvanized steel and shall include pre-punched mounting brackets. The housing shall be lined with 1/2" acoustical insulation. The outlet duct collar shall include an aluminum backdraft damper and shall be adaptable for horizontal or vertical discharge, square duct mounting collars. The access for wiring shall be external. The motor disconnect shall be internal and of the plug in type. The motor shall be mounted on vibration isolators. The fan wheels shall be off the forward curved centrifugal type, constructed of galvanized steel and dynamically balanced.
- B. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- C. Fan shall be a Greenheck model CSP-265, rated at 1172 CFM @ 1.0" ESP, 115V, 1Ø, 830 Watt.

2.7 Centrifugal Fans

- A. Duct mounted exhaust fan shall be of the centrifugal belt in-line type. The fan housing shall be a square design, constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
- B. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- C. The fan wheel shall be centrifugal backwards inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- D. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.

- E. Precision ground and polished fan shafts shall be mounted in permanently sealed pillow block bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
- F. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- G. Motor pulleys shall be adjustable for final system balancing. A NEMA 1 disconnect switch shall be provided as standard. Factory wiring shall be provided from motor to the handy box.
- H. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- I. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- J. Fan shall be provided with a factory matched gravity backdraft damper.
- K. Fan shall be a Greenheck BSQ-9-4, rated at 500 CFM @ .5" TSP, 115V, 1Ø.

2.8 Strainers

- A. Shall be semi-steel body, Y pattern, threaded ends, replaceable stainless steel strainer 20 mesh, 120 psi, blowout connection. Provide a 6 inch nipple and gate valve with 1/2 inch hose thread connection for blow down. Strainer shall be Hoffman Series 400, 400A or approved equal.

2.9 Manual Volume Dampers

- A. Duct systems shall have sufficient volume dampers, whether or not shown, to control and adjust the total volume of each system, each zone, in each branch and at each diffuser or grille. Volume dampers shall be of the butterfly type with 18 gauge galvanized iron blade. All dampers shall be equipped with Duro-Dyne type UNXLD locking quadrant. Dampers 25" in width and longer shall be provided with damper bearings on each end of the shaft. Bearings shall extend through ducts with one opposite quadrant, mounted on a 2" x 3" x 1/8" plate held to duct with sheet metal screws. Maximum height of single blades shall be 12".

2.10 Thermometers and Gauges

- A. Thermometers: Case shall be 9 inches long, smooth die-cast aluminum with metallic blue-black finish. Window to be clear acrylic plastic held in place with removable stainless steel cap.
- B. Tube to have lens front red appearing mercury tubing. Scale to have white background with jet black embossed figures and markings. Stem to be brass with union connections. Bulb chamber to be tapered to fit a matched taper in socket. 30°F to 240°F range, Terice No. BX21406, or approved equal.
- C. Gauges to be 2 1/2 inch diameter in drawn steel case and ring. Dial to be steel with white background and black markings on the outer scale and blue markings on the inner scale. Window to be clear glass. Pointer to be aluminum finished in black. Bourdon tube operation. Socket to

be 1/4 inch N.P.T. brass. Scale to be from 0-100 psi, figure intervals every 20 psi, minor graduations, every 2 psi. Trerice No. 800, or approved equal.

2.11 Insulation

- A. Pipe insulation shall be fiberglass with all service jacket, self sealing longitudinal lap, butt strips, and composite surface burning characteristics of less than 25 flame spread and 50 smoke developed. Fittings shall be insulated to same thickness as adjoining pipe, covers of PVC are acceptable. No staples. Insulation shall be 3/4" thick for all pipe sizes.
- B. Refrigeration Piping:
 - 1. Elastomeric insulation shall be expanded, closed cell, elastomeric thermal insulation, supplied in unslit tubing. Insulation shall be Armstrong AP Armaflex 2000 or approved equal.
 - 2. Joints shall be sealed with Armstrong 520 adhesive.
 - 3. Insulation shall be 3/4" thick for all pipe sizes.
- C. Duct Insulation:
 - 1. Insulate all fresh air intake ductwork internally with 1 inch thick, 3.0 lb. density fiberglass, suitably coated to prevent erosion. Liner to be applied in accordance with the recommendations of SMACNA Manual on "Fibrous Duct Liner".
 - 2. External insulation to be 1 1/2" thick Owens-Corning Fiberglass Faced Duct Wrap insulation, or approved equal. Install insulation with facing outside so that the tape flap overlaps insulation. Insulation to be tightly butted. Seam to be sealed with pressure sensitive tape, matching the facing. No staples.

2.12 Identification

- A. Pipe Marking:
 - 1. Snap-on Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
 - 2. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
 - 3. Small Pipes: For external diameters less than 6" (including insulation), provide either full-band pipe markers extending 360 degrees around pipe at each location.
 - 4. Large Pipes: For external diameters of 6" and larger (including insulation), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height
- B. Valve Tags:

1. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, with 3/32" hole for fastener. 1-1/2" diameter. Fill tag engraving with black enamel.
2. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain, or solid brass S-hooks of the sized required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Valve Schedule Frames:

1. For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.13 LP Gas Fired Finned-Tube Water Heaters

- A. Packaged, automatic, commercial, LP gas-fired, ASME labeled, 160-psig rated, finned-tube heat exchanger; with integral controls, draft diverter, sealed combustion chamber (direct vent), gas burner, gas train including gas regulator, manufacturers standard insulation, steel jacket, and intermittent ignition.
- B. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature.
- C. Water Heater Relief Valve: ANSI Z21.22

2.14 Boiler

- A. Boiler shall be high efficiency (greater than 80%) cast-iron, oil fired with a net IBR water rating of 95 MBH. Boiler shall be equipped with a tankless heater. Boiler shall be a Weil-McLain 368V-WT or approved equal.

2.15 Pumps and Circulators

- A. Factory-assembled and factory tested. Fabricate casings to allow removal and replacement of impellers without necessity or disconnecting piping.
- B. Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, bronze-fitted, radially split case design, with mechanical seals, and rated for 125 psig working pressure and 225 def* F continuous water temperature.
- C. Casings Construction: Cast iron, with threaded companion flanges for piping connections smaller than 2-1/2", and threaded gauge tapings at inlet and outlet connections
- D. Impeller Construction: Statically and dynamically balanced, closed, overhung single-suction, fabricated from cast bronze conforming to ASTM B 584, and keyed to shaft.
- E. Pump Shaft and Sleeve: Steel Shaft, with copper sleeve. Provide flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering the motor bearings.

- F. Mechanical Seals: Carbon steel rotating ring, stainless Steel spring, ceramic seat and flexible bellows and gasket.
- G. Pump Shaft Bearings: Oil-lubricated, bronze journal and thrust bearings.
- H. Pump Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- I. Motors: Resiliently mounted to the pump casing.
- J. Circulator shall be Bell and Gossett Series 60, rated for 4 GPM at 8' TDH.

2.16 Boiler Specialties

- A. Balancing valves shall be ported, bronze body, and ball. Bell & Gossett circuit setter or approved equal.
- B. Expansion tank shall be bladder type, 30 gallon, ASME stamped, Amtrol model SX-30 or approve equal.
- C. Expansion tank shall be 15 gallon, ASME stamped, with gage glass. Bell & Gossett model or approved equal.
- D. Drain for expansion tank shall be Bell & Gossett model DT-2 or approved equal.
- E. Expansion tank fitting shall be Bell & Gossett model ATF-12 or approved equal.
- F. Air separator shall be a Bell & Gossett model IAS-1/2 or approved equal.
- G. Pressure reducing valve shall be a Bell & Gossett model FB8, set at 12 psi, or approved equal.
- H. Backflow preventer shall be a Watts model 9D or approved equal.
- I. Flow controllers shall be Bell & Gossett model SA-3/4" or approved equal.

2.17 Thermostat

- A. Thermostats shall be Honeywell Model T87F1859 (T87F2873 for Heating only) or approved equal.

2.18 Convectector

- A. New convectector for the kitchen shall be rated at 17,000 BTU/hr at 10°F WTD, 170°F AWT. Unit shall be a Dunham and Bush Model SFH 64"L, 10"W, 26"H or approved equal.
- B. New convectector for entry shall be rated at 2,200 BTU/hr at 10°F WTD, 170°F AWT, unit shall be a Dunham and Bush Model SF with damper 24"L, 4"W, 14"H or approved equal. Mount unit 12" AFF.

2.19 Fin-tube radiation

- A. Radiation shall be rated at 530 BTU/hr at 10°F WTD, 170°F AWT, unit shall be a Sterling "Kom-Pak" with 3/4" tube, or approved equal.

2.20 Air Handling Unit

- A. Units shall be composed of a filter section, face and by-pass, coil section and fan section, with vibration isolation. Components shall be supplied by a single manufacture in a heating and ventilating configuration. Units shall be Carrier Model 39L size 21, 5000 CFM @ 1.25 ESP. 3HP, 208V, 3Ø, steam coil, IDT, 5 psi, -25°F entering air temperature, 122°F. leaving air temperature with steam coils, or approved equal.

PART 3 - EXECUTION

3.1 Miscellaneous Items

- A. Furnish and install all necessary anchor bolts, concrete inserts, steel beams, bars, bearing and leveling plates and incidental items as may be needed to install the work. Items to be built into masonry and concrete must be furnished to the respective trade at the proper time to be built in and include instructions and templates for their installation unless it is explicitly shown or specified otherwise.

3.2 Piping

- A. General: Check with other trades and prevent interferences of piping runs. No changes in the contract price will be allowed because of any work made necessary by failure to coordinate. The right is reserved to make minor offsets and directional changes required to meet structural or other interferences during construction. Generally follow indicated lines as shown on Drawings, exact layout to be made on the job. Allow space for valves, fittings, and insulation, and provide for thermal expansion and contraction. Piping shall be installed above finished ceilings or concealed in finished walls, where possible. When exposed, piping shall be run parallel or perpendicular to building surfaces, and as close to building surfaces as is practicable. Separate all hot and cold water piping by at least 6 inches, where possible, and prevent contact. Pitch steam piping down in the direction of flow. Pitch water piping up in the direction of flow at 1/4" per 10 foot length. Provide manual air vents at high points, and drains at all low points. Make changes in size and direction with fittings. Reductions shall be made with eccentric fittings with tops leveled for water piping and bottoms leveled for steam, and gas piping. Pipe thread compound shall be applied to male threads only. Use dielectric fittings between dissimilar metals.
- B. Gas Piping: Conform to requirements of NFPA 54.
 - 1. Concealed locations: Except as specified below, install concealed gas piping in an air-tight conduit constructed of Schedule 40, Seamless black steel with welded joints. Vent conduit to the outside and terminated with a screened vent cap.

2. Above-Ceilings: Gas piping may be installed in accessible above-ceiling spaces, whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.
 3. Partitions: Concealed piping shall not be located in solid partitions. Tubing shall not be run inside hollow walls or partitions unless protected against physical damage. This does not apply to tubing passing through walls or partitions.
 4. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter or elevator shaft.
- C. Provide pipe sleeve and seals at foundation and basement wall penetrations.
- D. Drips and Sediment Traps: Provide drip legs at points where condensate may collect, at building entrance, just prior to gas burning device, in locations readily accessible to permit cleaning. Do not place drips in locations likely to freeze. Construct drips using a tee with a capped nipple of three pipe diameters or 4", whichever is greater, from the bottom outlet.
- E. Pitch piping up in the direction of flow 1/4" in 15 feet. To change pipe size use eccentric reducers with level side down. Connect branch connections to top or sides of mains. Provide unions or flanges on all pieces of equipment. Provide strainers before all control valves, pressure reducing valves, and solenoid valves.

3.3 Pipe Hangers and Supports

- A. Support, anchor and guide piping systems to withstand static and dynamic load conditions; to allow for expansion and contraction; to prevent vibration and swaying; to maintain alignment and minimize vertical deflection. Exercise care in placing supporting devices so that structure is not weakened or impaired. Support horizontal overhead pipes with clevis or split ring hangers, rods, inserts, clamps. Where several lines of piping run as a common group, parallel and at same level, support on a common hanger bar of galvanized pipe, or channel section. Support copper tubing on split ring cast brass extension hangers. Where grouped with other piping on trapeze hangers, encase the supporting bar in a copper tube sleeve. Support risers, stacks, and other vertical piping at each floor with proper clamps. Install all hangers straight and true, and in perfect alignment. Locate no hangers near couplings, fittings, or bends in piping or from other piping or ductwork. Do not use wire, tape, metal bands, or other make-shift devices as means of support or attachment. Support horizontal piping in accordance with the following schedule:

MAXIMUM HORIZONTAL SPACING-FEET			
<u>PIPE SIZE</u>	<u>ROD SIZE</u>	<u>STEEL PIPE</u>	<u>COPPER TUBE</u>
Up to 1-1/4"	3/8 inch	7	6
1-1/2" to 2"	3/8 inch	9	8
2-1/2" to 5"	1/2 inch	10	10
6" to 8"	3/4 inch	10	10

- B. Provide galvanized insulation protection shields at all insulated piping supports and hangers for piping up through 2 inches in diameter. Provide rigid foam insulation inserts at all protection shields to prevent crushing of insulation and breaking of vapor barrier. Provide insulation

protection saddles and pipe rolls at all insulated piping supports and hangers for piping 2 1/2 inch and larger. Weld saddles securely to piping.

3.4 Pipe Sleeves & Escutcheons

- A. Provide for piping passing through walls, partitions, and slabs, sleeves sized at least 1 inch larger than OD of pipe for uninsulated lines and of pipe plus insulation for insulated lines. Terminate sleeves flush with finished surfaces. Set sleeves in place before placing concrete or securely fasten and grout in place. Exercise care in locating and setting of sleeves to assure accurate alignment. In absence of sleeves, use core drilled holes. Where insulated piping passes through barriers, use core drilled holes. Where insulated piping passes through barriers such as fire rated partitions, floors and walls, stop insulation and grout hole fully to bare piping with nonshrink materials. Grout to be flame-safe and meet all UL ratings. Where piping passes through non fire rated partitions, floors and walls, apply pipe insulation continuous through pipe sleeves.

3.5 Valves and Strainers

- A. Place valves in accessible locations with ample room for full opening, repacking, replacement of internal parts; with operating stem horizontal or vertically upward. Provide all drain, hand, check and all cocks, all air vents and all other valves as required and as shown for the complete and proper valving of the entire installation.

3.6 Dielectric Fittings

- A. Install dielectric fittings as follows:
 - 1. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.
 - 2. Install dielectric waterway fittings to connect piping materials of dissimilar metals in wet piping systems.
 - 3. Bronze bodied valves and devices installed in steel piping systems do not require dielectric fittings when both connections are made with steel piping, but **do** require dielectric fittings when the bronze bodied valves or devices are installed with one connection to steel piping and the other connection to copper piping. Iron bodied valves and devices installed in copper systems require dielectric fittings.

3.7 Insulation

- A. Provide and install 3/4" Armaflex on all suction lines outside of building. All lines (suction, liquid and drain) to be insulated inside of building with 3/4" Armaflex.

3.8 Pipe System Identification

- A. Install pipe markers on each system, and include arrows to show normal direction of flow.

- B. Locate pipe markers and color bands as follows: Whenever piping is exposed to view in occupied spaces, machine rooms, accessible spaces, and exterior non-concealed locations.
 - 1. Near each valve, control device, branch take-off (excluding short take-offs to fixtures and terminal units), at major equipment items and other points of origin and termination.
 - 2. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures, at access doors, manholes, above removable ceilings, and other access points which permit viewing.
 - 3. Spaced intermediately at maximum spacing of 50' along each piping run, and 25' in congested areas of piping.
- C. Valve tags: Provide valve tags on every valve, cock, and control device in each piping systems; excluding check valves, valves within factory-fabricated equipment units, plumbing fixtures faucets, convenience and lawn-watering hose bibbs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

3.9Boiler

- A. General: Install boiler on concrete base. Set and connect units in accordance with manufacturer written installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.
- B. Install thermometers on inlet and outlet piping.
- C. Install in compliance with NFPA 54.
- D. Provide direct vent system with double wall, combination air intake/flue pipe and vent cap. Vent system components shall be furnished by the boiler manufacturer in accordance with A.G.A. requirements. Below grade mop vent system, liberally, with water proof mastic.
- E. Commissioning: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate and train maintenance personnel.
 - 1. Provide the following before start-up final checks:
 - a. Fill system with water
 - b. Complete piping system tests.
 - c. Check for leaks in piping connections.
 - d. Check for adequate combustion air.

- e. Check for clear vent.
- f. Test for operation of safety controls and devices.
- 2. Perform the following as part of start-up procedures:
 - a. Energize circuits.
 - b. Adjust operating controls.
 - c. Adjust water outlet output temperature setting.

3.10 **Pumps**

- A. Comply with manufacturers written instructions
- B. Install pumps in accessible locations and arranged to provide access for periodic maintenance , including removal or replacement.
- C. Support piping and pumps separately so weight of piping does not rest on pumps.
- D. Provide valves that are the same size as the piping connected to the pump.
- E. Provide a non-slam check valve or triple-duty valve and a ball valve on the discharge of each pump.
- F. Provide a strainer and ball valve on the suction side of each pump.
- G. Provide a pressure gauge across the suction and discharge of each pump. Provide gauge cocks.
- H. Commissioning:
 - 1. Lubricate oil-lubricated bearings.
 - 2. Check that pump rotates freely by hand.
 - 3. Start pump and check for proper rotation.
 - 4. Observe the leaking from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.

3.11 **Tests and Start-Up**

- A. Refrigerant piping shall be tested using a mixture of refrigerant and dry nitrogen. Testing procedures and pressures shall be in accordance with ASA-B9. 1-1958 Safety Code for Mechanical Refrigeration. This Subcontractor shall furnish all labor and supplies for carrying out the work of the testing.

- B. After wiring has been completed, purge all systems and evacuate with a vacuum pump for not less than four (4) hours, twice, and add the correct quantities of refrigerant and the proper viscosity oil. The compressors shall not be used for evacuation. All systems shall be started and adjusted for proper operation, and shall produce temperatures as noted on the Drawings.
- C. Charging of refrigerant from service tank to system shall be done through a temporary drier. The system/dryer shall not be used for this purpose. Charge only after double evacuation.
- D. The cut-out point of the low pressure control of all compressors shall be set below the normal operating pressure so that control of the machine will normally be room thermostat.

3.12 Cleaning

- A. Piping: Each system of piping shall be blown through, washed out and/or flushed after completion to remove grit, pipe dope, dirt, sand, etc., from coils and piping for as long a time as required to thoroughly clean the apparatus. All elements within the system that may be damaged by the cleaning operation shall be removed or otherwise protected during the operation. Repair or replace any control valves or other system components which do not function properly due to damage during the cleaning operation or because of imperfect cleaning of piping system. All strainers shall be inspected and cleaned as often as required and left in clean condition.
- B. Ductwork: Before the duct systems are tested and balanced the interior of the ducts shall be cleaned thoroughly, so that no dirt, dust, or other foreign matter can be deposited in or carried through the systems, or discharged through the outlets. Cheesecloth shall be secured over each opening for entraining such particles during the cleaning.

3.13 Sequence of Control (ATC compressors need side seals)

- A. Thermostat shall start circulation pump for its zone upon a drop in temperature below the set point. Burner to operate upon a call for heat in any zone only, as per manufacturers instructions.

3.14 Testing & Balancing

- A. Testing and balancing shall be performed by a qualified, independent testing company, and shall not begin until all systems have been completed, cleaned and in full working order. Balance, test and adjust all air moving equipment, air-distribution, return, exhaust, hydronic and control systems. At completion of all balancing and testing, leave all equipment, systems, components, etc., adjusted to meet design requirements. If requested, conduct tests in the presence of the Engineer. All quantities shall be adjusted to within 10% of design requirements.
- B. Perform all tests in accordance with standard procedures such as those outlined by the Associated Air Balance Council (AABC), Sheet Metal and Air-Conditioning Contractors National Association, Inc. (SMACNA), NEBB, and ASHRAE. Only nationally recognized test report forms and procedures shall be used. All applicable portions of the test report forms shall be completed. The Engineer may request a recheck or resetting of any outlet, fan, pump or equipment for a period of one year after final acceptance of the project. Make necessary adjustments to fan sheaves as required to balance the air systems and if adjustments cannot be

made within the limits of the sheave then new sheaves and belts shall be provided at no additional cost. Within 15 days after completion of testing and balancing, submit to the Engineer for review, two (2) copies of the testing and balancing results.

END OF SECTION 15200